EPA-AA-ECTD-79-7.1

air pollution control association

Reducing Air Pollution from Motor Vehicles - Developments in the In-Use Strategy

Paper No 79-7.1

Presented at the 72nd Annual
Meeting and Exhibition
June 25, 1979

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Introduction

Widespread best describes the extent of current air quality problems of the major populated areas of this country. In 1978, based on ambient air quality data, the U.S. Environmental Protection Agency (EPA) classified areas of the country as attainment or non-attainment with the health based ambient air quality standards. Of the 105 urban areas with populations greater than 200,000, 104 exceeded one or more of the ambient air quality standards. The only attainment area was Honolulu. In many areas violations were frequent with ambient concentrations of the automotive related pollutants (ozone and carbon monoxide) often exceeding the ambient air quality standards by several hundred percent. For example, Los Angeles and Houston have measured ozone levels above 0.30 parts per million (ppm), compared to the revised ambient standard of 0.12 ppm. (In January 1979, after extensive review of relevant data, EPA raised the ozone ambient air quality standard from 0.08 ppm to 0.12 ppm. Preliminary indications are that approximately 10 major urban areas will change from non-attainment to attainment.) Chicago, Denver and Las Vegas are among numerous cities with carbon monoxide (CO) ambient concentrations over twice the 9 ppm eight hour ambient CO standard.

Automobiles and other mobile sources are a major contributor to ozone and carbon monoxide air pollution. In a typical urban area, over 50 percent of the hydrocarbons (which react in the presence of sunlight and oxides of nitrogen, another automobile pollutant, to form ozone) and over 90 percent of the carbon monoxide are emitted from mobile sources. This is true even though automobiles, since 1975, have been designed to emit hydrocarbons and carbon monoxide at rates that are only 35 percent and 44 percent of those from early emission controlled vehicles.

Mobile Source Emission Control Strategies

In the Clean Air Act of 1970, Congress included an agressive program to control mobile source pollutants. The Congress required that automobile emissions be reduced by 90 percent by the 1975 model year; events have delayed the implementation of this requirement to 1981 (The requirement for NOx reduction has been eased to 75 percent). The enforcement of this requirement consists of four basic elements: prototype certification, assembly line testing (SEA), recall, and inspection and maintenance. The first two elements deal with new cars, the latter two with in-use vehicles. The period of the vehicle's life over which each strategy applies is shown in Figure 1.

Certification

The objective of certification is to demonstrate the capability of the complete vehicle, including emission controls, to meet the prescribed emission standards for the vehicle's useful life (50,000 miles for light-duty vehicles). This is accomplished by emission testing preproduction prototypes, driven on a dynamometer over a typical 7.5 mile urban driving cycle. Two types of vehicles are tested. Early prototypes representing basic engine/emission control system combinations are tested for 50,000 miles to determine emission control system durability. A larger number of prototypes, each closely representing a model to be produced, is tested for emissions after 4000 break-in miles have been accumulated. These test results, expressed in grams per miles, are combined with the deterioration rates from the early prototypes to establish a 50,000 mile emission value. If this value is less than the emission standard, the prototype is certified and production may begin. Over a thousand vehicles are tested in this manner each year. The procedure establishes that each vehicle type produced is capable of meeting emission standards for its useful life.

Selective Enforcement Audit (SEA)

SEA is an assembly line test methodology used to ensure that individual vehicles comply at the time of production with emission standards. Manufacturers perform the audit testing on groups of similar vehicles; each group typically contains 10 vehicles. The model types to be tested are selected by EPA without advance notice to the manufacturer. Sixty percent of the vehicles in a group must meet federal emission standards, however experience has shown that in the first year of SEA testing over ninety percent of the vehicles produced comply on a per standard basis (75 percent comply with all three pollutants). In 1977 thirty-four audits involving 324 vehicles were performed. Although this testing represents only a small fraction of the total number of vehicles produced annually, the presence of the SEA program has caused a substantial improvement in production quality control; manufacturer assembly line testing was increased from 1400 cars in 1974 to 19,000 cars in model year 1977.[1]

Recall

Recall, provided for under section 207(c) of the Clean Air Act, is designed to remedy defects in emission control equipment caused by manufacturer design, production or unanticipated deterioration, and to increase manufacturer concern with the in-use emission durability of their products. Since 1972, over 12 million vehicles have been recalled; 8 million since 1975. Noteworthy is in 1978 eighteen of 28 recalls were voluntarily initiated and performed by the manufacturer. The percentage of vehicles returned under the recall is only 65 percent.[1] For the program to be more effective, a mechanism to ensure recall generalized repairs are performed is needed.

Inspection and Maintenance (I/M)

The fourth and final element of the mobile source emission control strategy is inspection and maintenance (I/M). Unlike certification, SEA, or recall, I/M is a state or local government operated program. The objective of I/M is to ensure that vehicles are achieving, in-use, the low emission levels for which they were designed. Extensive test data have shown that proper maintenance is not being performed on many vehicles, and tampering with emission control devices is prevelent. I/M addresses these causes of excessively high in-use emissions through the periodic inspection and if necessary, repair of in-use motor vehicles. Most often a short idle test is utilized to screen out those vehicles needing maintenance.

The watchdog arm of Congress, the General Accounting Office (GAO), recently reviewed the entire mobile source emission control strategy. In their report, the GAO concluded that I/M was the essential element of the mobile source control strategy needed to ensure emission reductions from mobile sources are realized.[1]

Improvements to the certification and SEA processes are also underway. EPA recently promulgated regulations which require that vehicles meet emission standards anywhere within the range of adjustment of certain components.[2] This action was in response to data which showed improper adjustments were a major cause of high in-use emissions. EPA is also considering rules which could result in maintenance performed on certification test vehicles being more representative of that performed in-use. Methods of factoring in-use emission deterioration into the certification process are also being studied, as is a more stringent assembly line (SEA) test criterion.

All these changes are oriented towards improving in-use emission performance. Only I/M, however, can provide assurance that necessary maintenance is performed and emission control system tampering is minimized.

In-Use Vehicle Emission Performance

EPA's certification program requires that each vehicle type be capable of meeting federal emission standards, and the SEA assembly line test program results show most vehicles meet federal emission standards at the time they are produced. Yet in-use vehicle test programs consistently show that nearly one half of one year old cars have emission levels above the applicable standards. The fraction of high emittors increases from this level with age, as shown in Figure 2.

A major test program conducted by EPA disclosed the reason for this frequency of high in-use emissors.[3] EPA tested 300 domestic, low mileage in-use 1975 and 1976 model year vehicles. A sequence of maintenance, beginning with correction of disablements and maladjustments (except idle mixture and speed), and followed by idle mixture and speed adjustments and finally a full tune-up, was performed, in order, until the vehicle met emission standards. An emission test (Federal Test Procedure) was performed at each step. The program confirmed the high occurance of vehicles exceeding federal emission standards (58%), but showed that correction of disablements and minor idle adjustments brought most cars (73%) under the emission standards. The conclusion drawn from this study was that improper maintenance and lack of maintenance were chief causes of high in-use emissions. The inspection and maintenance strategy offers the most effective solution to this problem.

A second EPA study disclosed that tampering with emission controls is also a widespread phenomenon.[4] This study found 19 percent of 1973-78 model year vehicles had some form of gross tampering with emission control devices. The tampering rate increases with age, reaching 32 percent at 5 years. The exhaust gas recirculation system (EGR), which is the primary control of oxides of nitrogen emissions, was the most frequent target of tampering. Table I presents a list of control devices often tampered with, the frequency of tampering, and expected effects on emissions.

I/M offers the most direct method of reducing tampering. Tampering reduces the chances of passing an I/M test. The tampering study showed tampered vehicles twice as likely to fail an I/M test incorporating New Jersey idle standards. I/M also creates an incentive not to tamper with emission controls. Preliminary data from New Jersey, which has an I/M program, indicate the gross tampering rate is one half that of the national average, as shown in Figure 3. A quick physical inspection of key emission control devices should also be effective in further reducing tampering. The items listed in Table I can be physically inspected in less than five minutes.

An additional form of tampering is use of leaded gasoline in cars designed to use only unleaded fuel. Several surveys have indicated that fuel switching is occuring in 5 to 10 percent of vehicles. Since lead can seriously reduce the effectiveness of the catalytic converter, used on most automobiles since 1975, the implications on emission control are obvious, although a more quantified assessment of the impact will have to await additional information on frequency of switching and the effect of leaded fuel on emissions from various control systems. The increasing price differential between leaded and unleaded gasoline (currently unleaded is five cents higher) coupled with projected shortages of unleaded fuel suggest this problem will get worse.

Inspection and maintenance can reduce fuel switching in two ways. A physical inspection can identify vehicles with tampered filler neck inlet restrictors. The reduction in catalyst efficiency resulting from use of leaded fuel increases the probability of failing the I/M test. Public awareness of this fact should help reduce fuel switching.

Inspection and Maintenance as an Emission Control Strategy

In the 1977 Amendments to the Clean Air Act (PL-95-95), Congress established the end of 1982 as the deadline by which the states must meet the health based ambient air quality standards. Congress recognized that this would be a difficult goal to achieve because

FIGURE 1

MOBILE SOURCE EMISSION CONTROL STRATEGIES

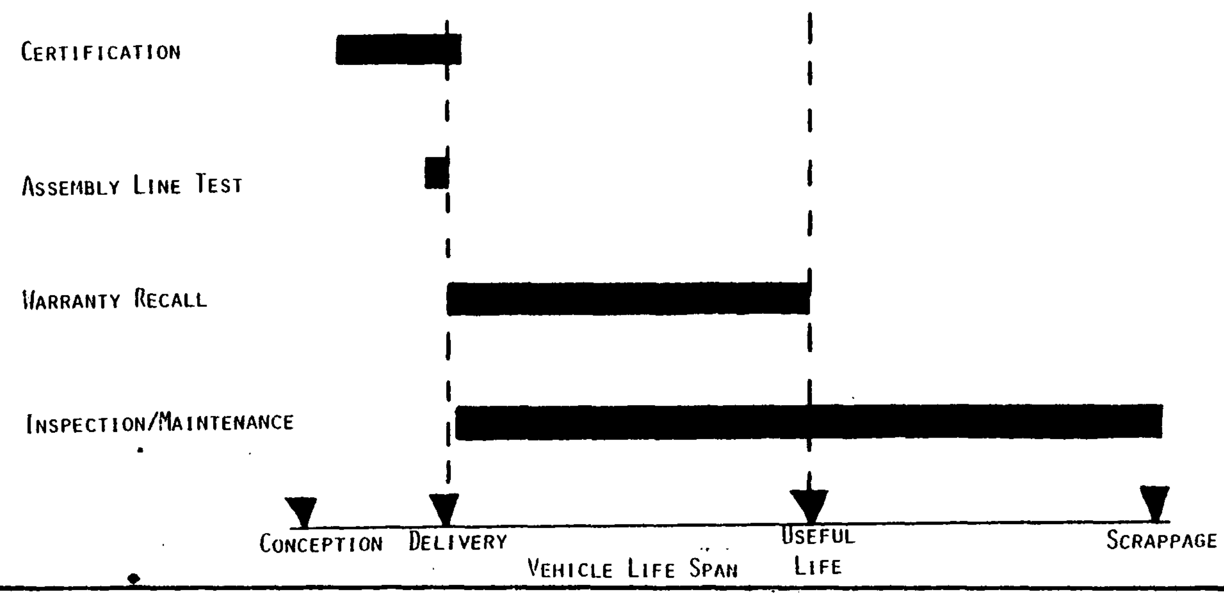


FIGURE 2

PERCENT OF VEHICLES FAILING FEDERAL EMISSION STANDARDS BY VEHICLE AGE

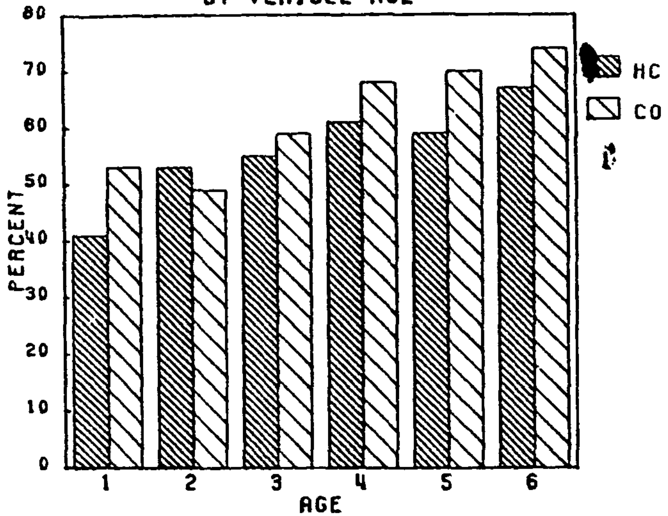
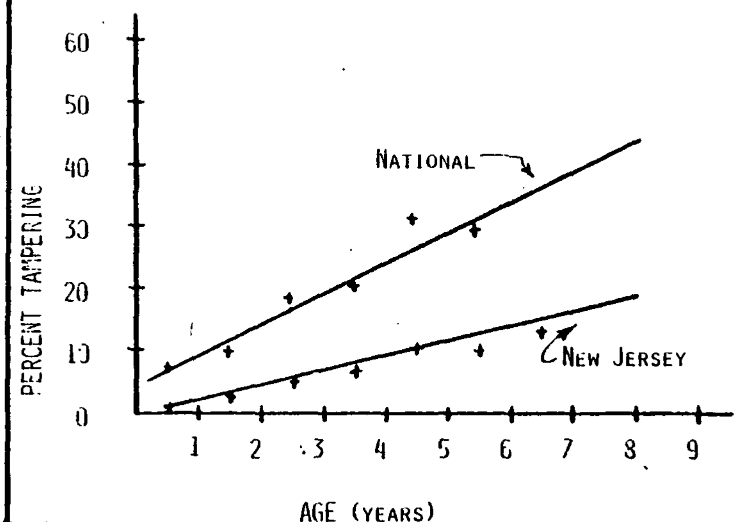


FIGURE 3

GROSS TAMPERING VS AGE



of the severity of carbon monoxide and ozone problems in many urban areas. Thus Congress established a five year extension for achieving the air quality standards for these two pollutants.

To obtain the extension all reasonable control strategies would have to be adoped by the state. Congress concluded that I/M was a reasonable control strategy, and thus I/M became a prerequisite for the extension. Current data indicate over 50 urban areas will require an extension and thus must implement inspection and maintenance programs.

A common characteristic of motor vehicle emission performance is emissions deteriorate with time. This deterioration is present even if proper and timely maintenance is performed. Lack of maintenance and tampering increase the rate of deterioration. Repair of vehicles failing an I/M test lowers the emission levels, however, this is followed by deterioration. At the next inspection, emissions are lowered once again. Repeated inspection and repair of the fleet leads to a growing emission benefit the longer an I/M program has been in effect. Emission benefits versus time for two different stringency programs are shown in Figure 4. After five years, the carbon monoxide emission reduction (30% stringency) is nearly twice that of the first year of the program.

EPA policy requires an I/M program to produce a 25 percent reduction in light duty vehicle emissions in 1987 compared to what the emissions would have been in the absence of I/M. Most planners have calculated that this mobile source emission reduction will improve the ambient ozone levels by 3 to 10 percent and improve the ambient carbon monoxide levels by 20 to 25 percent. There is, of course a strong interest in verifying these estimates. This is difficult because the many variables that influence air pollution levels, such as meteorology and pollutant transport, dictate that many years of data be available to establish a trend.

An analysis linking I/M to reductions in ambient carbon monoxide was recently published by the University of Wisconsin[5]. The study was based on six years of ambient CO data collected in New Jersey. After accounting for influencing factors such as meteorology and increases in vehicle miles traveled, the study attributed the improvement in New Jersey CO air quality to the State's

I/M program, which began in 1974, and more stringent new car emission standards. Figure 5 shows the trend in New Jersey CO air quality compared to gasoline usage.

The relationship between hydrocarbon reductions and improvements in ozone air quality is complicated by photochemical reactions and pollutant transport. One of the earliest hydrocarbon control programs and the most complete ozone monitoring network is in the Los Angeles basin. Average ozone levels in the basin have decreased 45 percent since 1956, indicating emission reductions, much of which have come from the control of mobile sources, have resulted in improved ozone air quality.

Current Experience with I/M

Inspection and maintenance is a proven emission control strategy. Seven states now have programs requiring mandatory inspection and repair of failed vehicles in operation. Program features are described in Table II.

Two basic types of administration of an I/M program exist. A centralized I/M program features specialized inspection facilities, operated by the state or local government or a contractor, in which production line-like inspections are performed. Vehicles failing the inspection obtain repairs at a private repair facility and then return for reinspection. Features of the centralized program include separation of inspection and repair functions; centralized facilities which facilitate good quality control, including computerization; and in the contractor run system, low initial capitol cost to the governing body. Arizona and California (Los Angeles area) currently operate contractor centralized programs, while Oregon (Portland), Ohio (Cincinnati), and New Jersey (statewide) have programs run by state or local government. The New Jersey and Cincinnati programs were added to an existing safety inspection program.

The decentralized I/M program features inspection and repair at private garage facilities. Decentralized programs offer the convenience of "one stop shopping", and the relative ease and low cost of adding the emission inspection to an existing private garage safety inspection program. The decentralized program offers unique problems as well. Because the decentralization means a larger number of inspection stations, each requiring an exhaust analyzer and trained inspector, quality control becomes a major undertaking. The governing agency must license the inspection stations and inspect them periodically. Inspectors must be trained to diagnose and maintain instrumentation as well as perform the emission test. These requirements place a more difficult administrative burden on the state than does a centralized program. Nevada (Las Vegas and Reno) and Rhode Island (statewide) currently operate decentralized I/M programs.

Two types of emission inspection tests are currently used. The idle test is the most predominate, used by all operating programs with the exception of Arizona. Arizona preconditions the vehicle with a loaded mode test which requires the use of a chassis dynamometer. The pass/fail decision is made based on idle results, however. Loaded mode testing offers several advantages which include better diagnostics and the ability to determine nitrogen oxide (NOx) emission performance. A third inspection procedure, not currently in use, is a physical and functional inspection of the vehicle's engine and emission controls.

Portland Study

The current operating programs have demonstrated that I/M programs can be effectively administered and produce substantial reductions in idle emissions. The best measure, however, of vehicular emissions is the Federal Test Procedure (FTP), a test methodology too time consuming for use in operating I/M programs. To determine the FTP emission reductions resulting from I/M and to answer other technical and administrative questions concerning I/M, EPA has undertaken a study of the Portland, Oregon I/M program. Major questions the study, which involves testing of approximately 3000 vehicles, is designed to answer are:

- Can the short test detect high emitting vehicles?
- What emission reductions (FTP) result from maintenance?
- How do emissions deteriorate after maintenance?
- What is the expected net (annualized) emission benefit?

With the study over 75 percent complete, answers to these questions have been obtained.[6] The conclusion of the study is I/M is extremely effective in reducing emissions from in-use vehicles. A brief summary of the study results is presented below.

The short idle test used in the Portland program has proven extremely effective in identifying those vehicles needing maintenance. Emissions, as measured by the FTP, are 2 to 3 times higher for vehicles failing the idle test than those passing, as shown in Figure 6. The characteristic of failing the dirtier cars while passing, on the idle test, marginally high emittors is a key factor which contributes to the cost effectiveness of I/M. Errors of commission (vehicles failing the idle test which do not need maintenance) are under 5 percent.

The emission reductions resulting from corrective maintenance to those vehicles failing the idle test are substantial. These reductions, separated by vehicle emission control technology, are shown below.

	Emission Reduction due to Maintenance	
Model Year	HC %	CO %
1972-74	25	37
1975-77	42	47

As previously stated, emissions deteriorate with time. Two factors lead to the emission deterioration following maintenance shown in Figures 7a and 7b. (These figures include vehicles that both passed and failed the state inspection). In addition to normal aging and wear, the Portland study has shown approximately 10 percent of vehicles are experiencing a rapid emission deterioration. Emission results measured on each vehicle at quarterly intervals suggest readjustments to engine parameters, particularly idle mixture, are occurring. Investigation into this phenomenon has not been completed at this time. As discussed below, the fleet emission reductions occurring in Portland are substantial even after deterioration is taken into account.

The importance of emission deterioration characteristics is deterioration is a prime determinant of the amount of emission reduction realized as a result of I/M. A preliminary estimate of the annualized benefit resulting from I/M, as represented by the area between the Eugene, Oregon and Portland, Oregon curves (Figures 7a and 7b) shows emission reductions resulting from I/M for the 1975-77fleet of 24 percent HC and 34 percent CO. These

Figure 4
I/M BENEFIT RELATED TO STRINGENCY
OF PROGRAM

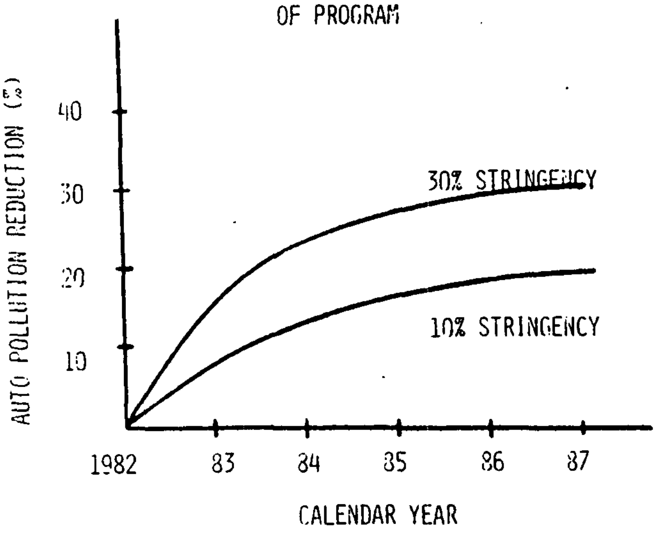


Figure 6
FTP EMISSION LEVELS OF CARS
PASSING AND FAILING THE OREGON
INSPECTION TEST (1975-7 Models)

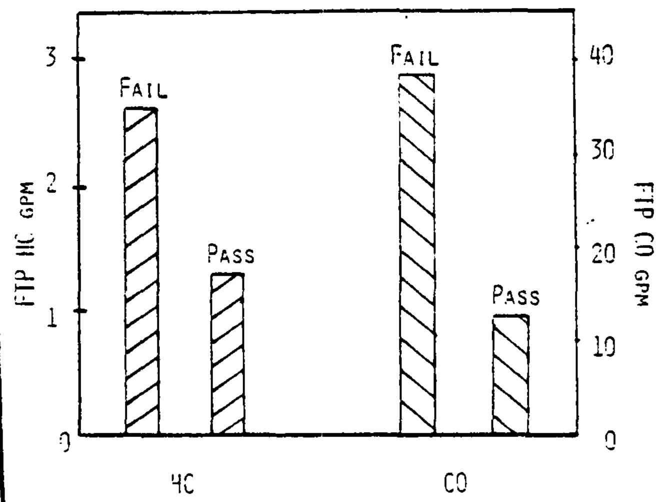
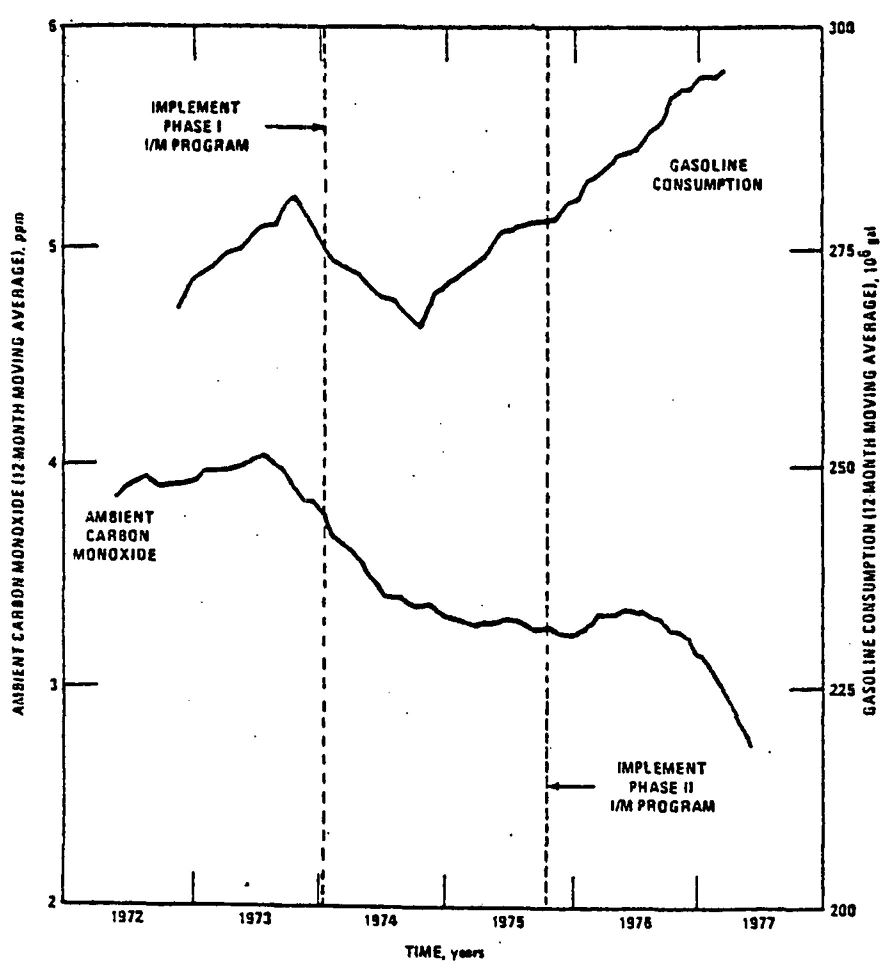


Figure 5
CO TRENDS IN N.J. (18 sites)



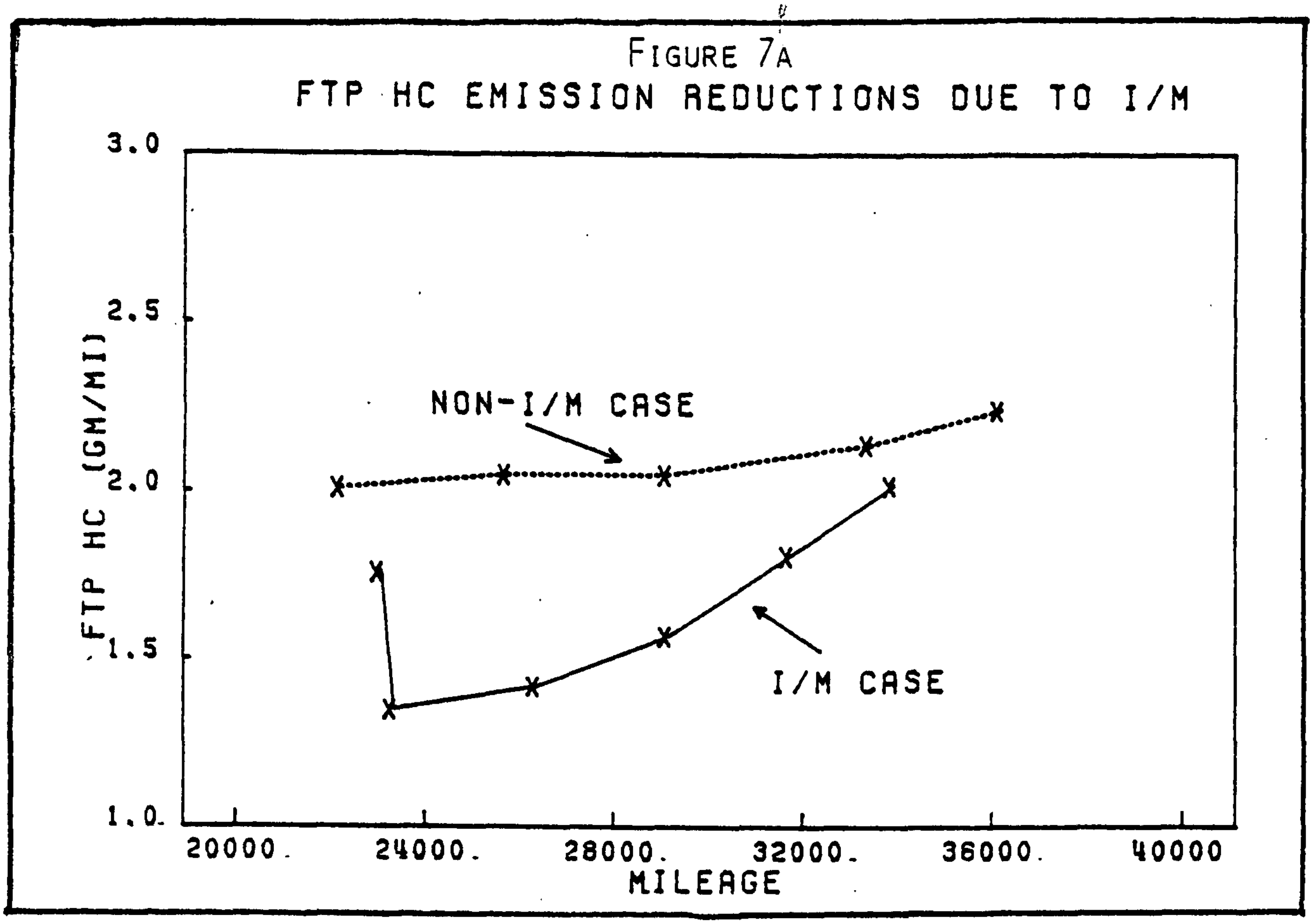


FIGURE 7A
FTP HC EMISSION REDUCTIONS DUE TO I/M
FTP HC (GM/MI)
3.0
2.5
2.0
1.5
1.0
NON-I/M CASE
I/M CASE
20000.
24000.
28000.
32000.
36000.
40000
MILEAGE

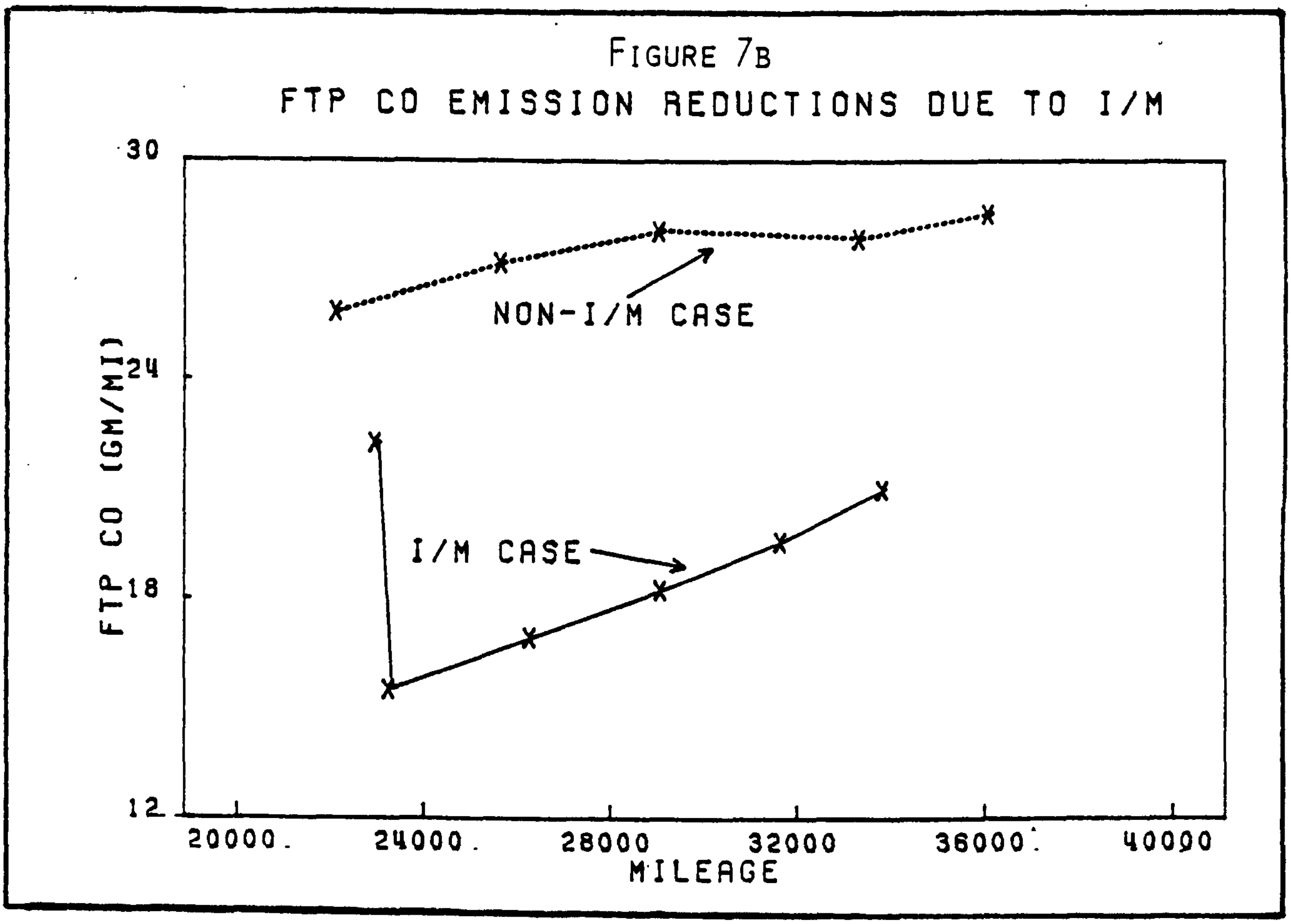


FIGURE 7B
FTP CO EMISSION REDUCTIONS DUE TO I/M
FTP CO (GM/MI)
30
24
18
12
NON-I/M CASE
I/M CASE
20000.
24000.
28000
32000
36000
40000
MILEAGE

reductions exceed those derived from Appendix N (MOBILE1) for the same scenario. (MOBILE1 is a computer program which calculates I/M emission reductions; documentation is available from EPA, Ann Arbor, MI.)

Mechanic Training

Additional emission reductions can be achieved as a result of mechanic training. EPA recognized this and in Appendix N has provided additional emission credit for those States that implement a mechanic training program. An example of the additional benefits is shown in Figure 8. In this example the emission levels of 1975-76 model year vehicles restored by EPA to manufacturer's specifications are shown to be lower than the emission levels of repaired Portland study vehicles. (Few mechanics in Portland have been trained in emission related maintenance.) Appendix N indicates mechanics training can nearly double the emission benefit resulting from I/M for the fleet evaluated in 1987.

EPA strongly recommends that states adopt mechanic training programs. In addition to the larger emission reductions which can be achieved, a properly adjusted vehicle operates better, achieves better fuel economy (3 to 4 percent), and the occurrence of improper or unnecessary repairs will be reduced. These factors lead to improved consumer satisfaction with their vehicles and I/M. EPA and Colorado State University have developed a mechanic training course and can provide assistance in the implementation of a mechanic training program.

Cost

A factor contributing to the consumer acceptance of I/M is the reasonable costs of the program. Inspection fees can be expected to range from 5 to 10 dollars. For the minority of vehicles which fail the inspection test, repairs will average 15 to 30 dollars, with the median value typically below 15 dollars. The actual fees and repair costs for current operating programs are shown in Table II.

Section 207 Warranties

The Clean Air Act provides for two warranties that can benefit the consumer. The 207(a) warranty warrants emission control systems from defects in materials and workmanship for 5 years or 50,000 miles, whichever comes first. The 207(b) warranty differs in that it is triggered by failure of an I/M test. If a vehicle fails the inspection test and has been properly maintained, the manufacturer is responsible for repairing the vehicle. The 207(b) warranty, which is expected to be available for 1981 model year and later vehicles only, is applicable for 50,000 miles for most emission control devices. Certain engine components which affect emissions but were in common use prior to emission standards (1968) are warranted for only 24,000 miles. It is planned to have the 207(b) warranty available for the idle test (free idle and 2500 rpm) and 2 mode loaded test. Preliminary indications are the 207(b) standards will be at least as stringent as state I/M emission standards now in use.

Future Technology Vehicles

The most common emission related malperformances of current technology vehicles are idle mixture and other tune-up adjustments. The parameter adjustment regulations[2] and a significant change in technology in the 1981 model year will result in a reduction of the occurrence of these failure modes. This change in technology is resulting from a more stringent federal nitrogen oxide (NOx) emission standard in addition to other factors such as fuel economy standards.

The technology to be introduced on most domestic models in 1981 consists of a computer controlled fuel system. An oxygen sensor located in the vehicle exhaust pipe senses the correct (stoichiometric) air/fuel ratio and commands the carburetor to provide the correct amount of fuel. The development of this concept, required to effect a reduction in NOx using a 3-way catalyst, has lead to the computer control of other engine parameters such as ignition spark timing, exhaust gas recirculation rates, idle speed, evaporative cannister purge rate, air pump control, and so on.

The assessment of the emission failure rate of these new technology vehicles, in the absence of significant field experience, is a matter of conjecture and history at this time. A second factor which affects the impact of these vehicles on the environment, and relates to the need for continued I/M, is the severity, in terms of emission levels, of potential failure modes. Data on this factor are now becoming available.

EPA has recently tested several prototype vehicles to determine their emission levels resulting from certain component failures. Failure modes investigated include failure of the input devices and outputs of the onboard microcomputer. (A key input is the oxygen sensor, a maintainable item with current replacement intervals ranging from 15,000 to 50,000 miles). Based on the current prototype designs, failures or disconnects of the input and output devices result in a discrete calibration being selected for the continued operation of the vehicle. The operating points selected are usually at the fuel rich or lean limit of the carburetor control system. Designs examined to date predominately select fuel rich operation.

Emission tests of a 1981 prototype vehicle operated at rich and lean limit failure modes are shown in Figure 9. Rich operation for this and other prototypes tested to date usually results in emissions of HC from 2 to 8 times the Federal standard, and up to 12 times the Federal CO standard. Lean operation typically increases hydrocarbon emission levels to 2 to 3 times the standard. Noteworthy is the failed rich condition is the most common selected failure mode. Driveability tests of several prototypes indicate vehicle performance is unaffected by the failure, leaving little incentive for the owner to fix the car. (Fuel economy will drop 10 to 30 percent, however).

The extremely high emission levels in the failed modes suggest that inspection and repair will be necessary even if the in-use failure frequency decreases. Also, these vehicles will not be maintenance free; periodic replacement of the oxygen sensor is one example of required maintenance. In addition there is no evidence the current frequency of tampering and misfueling will decrease as a result of the new technology. These factors all suggest periodic inspection of post-1981 vehicles will be an effective and necessary emission control strategy.

An on-board computer offers the possibility of a self diagnostic capability. General Motors will feature on its 1981 models a dash-board light which, through a Morse code like system, can tell the mechanic which element of the electronic control system is defective. No special tools are required. Incorporating such a check into an inspection and maintenance program is an attractive possibility.

EPA's advanced prototype testing has shown that the idle test may not be effective in detecting high emitters on certain advanced

FIGURE 8

POTENTIAL EMISSION REDUCTION WITH MECHANIC TRAINING
(1975-77 MODELS)
FLEETWIDE

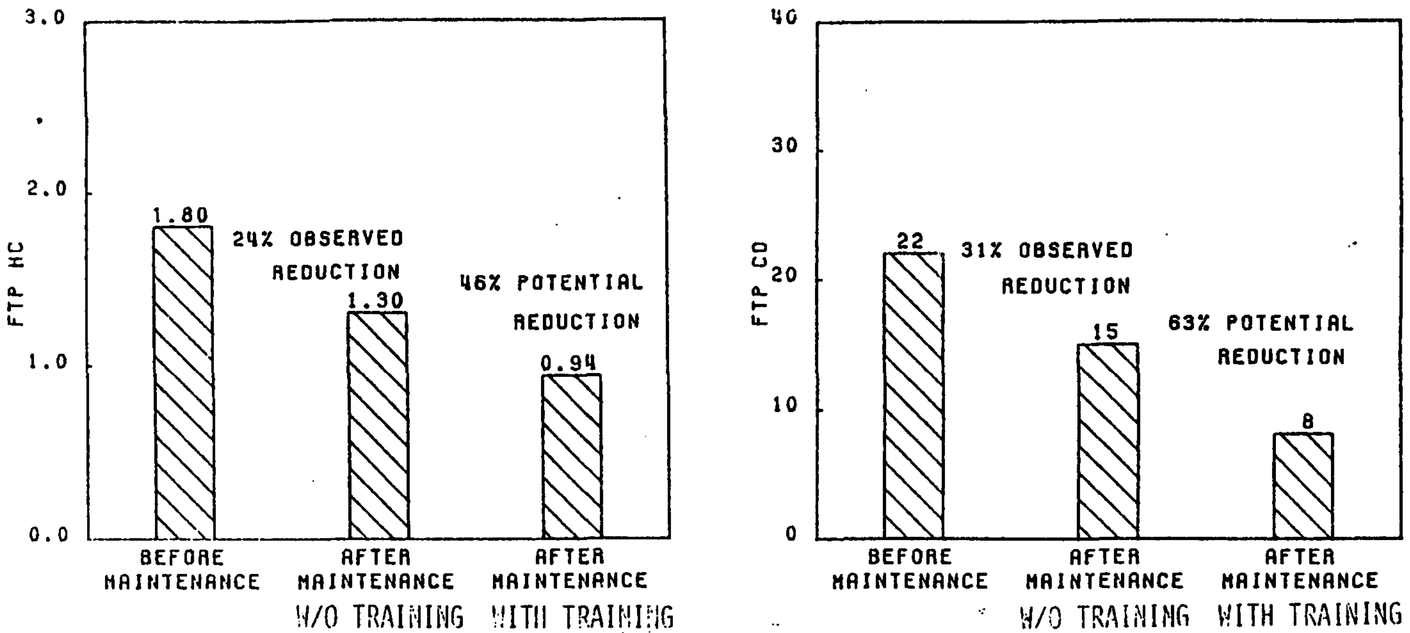
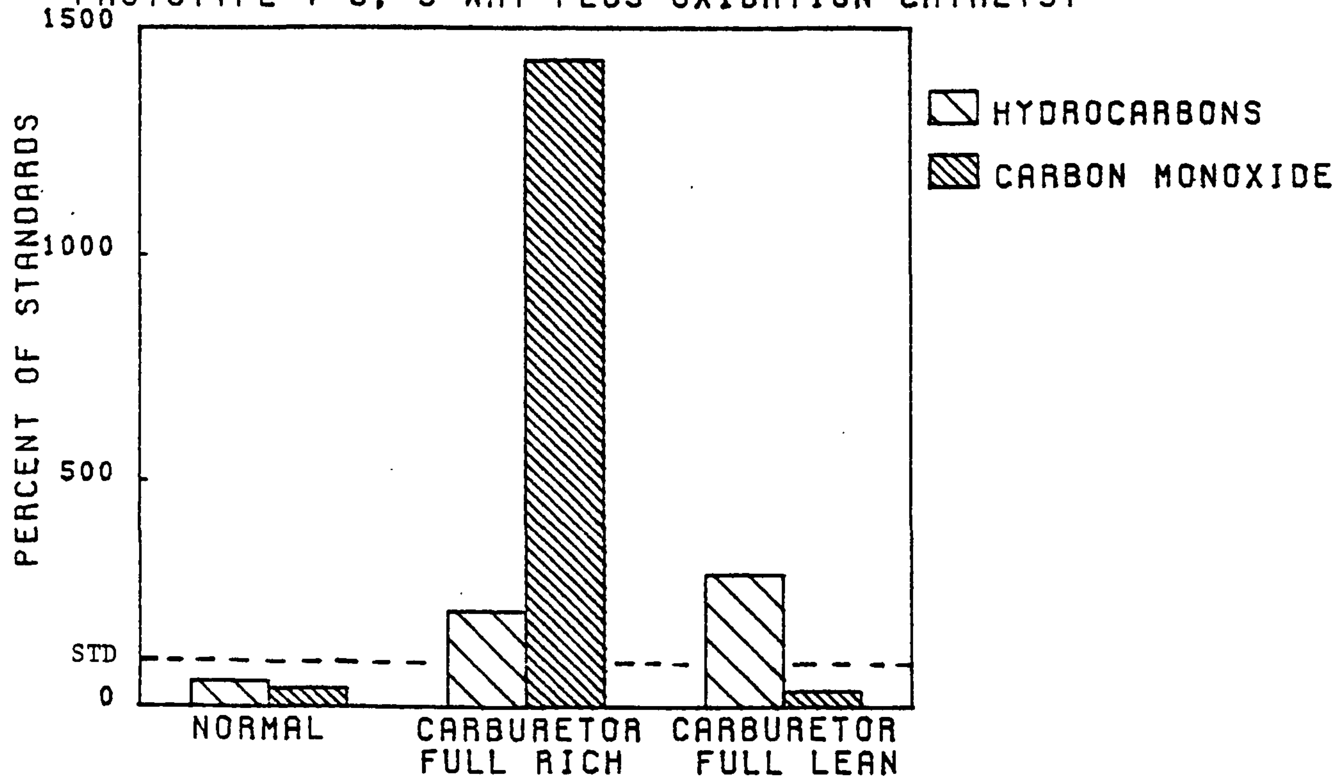


FIGURE 9
FAILURE MODE EMISSION LEVELS
PROTOTYPE V-8, 3-WAY PLUS OXIDATION CATALYST



technology vehicles. Two other tests have shown promise, however. The high speed idle (2500 rpm) appears to be effective as does a loaded test. These tests measure performance in the off-idle mode. The high-idle test is now used as a preconditioning for the idle test. Due to equipment considerations the loaded test, which requires a dynamometer, is usually only considered for centralized systems. Arizona has reduced the time required to perform the loaded test to a point at which the time is comparable to the idle test. This implies that states developing centralized programs should consider loaded mode testing as an investment towards effective testing of advanced technology vehicles. States could incorporate the necessary dynamometer pits and utility connections in the design of their inspection facilities. Dynamometers could be added at a later date if necessary. (The dynamometer adds only a few cents to the cost of each inspection).

Conclusions

This paper has touched on a wide number of subjects relevant to the decision on establishing a vehicle emission inspection program. The major points and conclusions are:

- Inspection and maintenance programs are the necessary completing link in the mobile source emission control strategy.
- The majority of in-use motor vehicles are exceeding the federal emission standards to which they were designed.
- Lack of proper maintenance is the main cause of these emission failures.
- Tampering, and misfueling catalyst vehicles with leaded gasoline, also contribute to excessively emitting vehicles.
- Inspection and maintenance programs can effectively deal with these causes of excess emissions.
- EPA's Portland Study demonstrates that I/M is effective in reducing emission levels.
- The short idle test is an extremely effective mechanism for screening out those vehicles most in need of repair.

- The cost of repair for those vehicles failing the inspection test is low; the average cost in current operating I/M programs is 15 to 30 dollars.

- I/M will be needed for the new technology vehicles that will be introduced in the early 1980's.

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Table 1
Tampering Rates and Emission Impact
(Reference 4)

Item	Tampering Rate %	HC	CO	NOx
PCV Valve	3	↑	↑	
Evap Cannister	3	↑		
Air Pump Removed	3	↑	↑	
Air Pump Belt Missing	6	↑	↑	
Catalyst Removed	1	↑	↑	
EGR Valve	12			↑
Fuel Filler Neck Removed	3	↑	↑	
Vacuum Spark Retard	10	↑		↑
Air Cleaner	1	↑	↑	

Table II
Operating I/M Programs

Location	Type	Test Type	Began	Fee	Average Repair Cost
New Jersey	Centralized	Idle	1974	$2.50[b/]	$16
Arizona	Centralized	Loaded[c/]	1977	$5.00	$23
Oregon	Centralized	Idle	1975	$5.00	$29
Rhode Island	Decentralized	Idle	1979	$4.00[b/]	-
Nevada	Decentralized	Idle	1977	$14-16[a/]	-
California (LA)	Centralized	Idle	1979	$11.00	-
Ohio (Cincinnati)	Centralized	Idle	1975	$3.75[b/]	-

a/ includes basic engine adjustments

b/ includes safety inspection

c/ pass/fail decisions based on the idle portion only

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